Space Weather Technical Forecast

Issued on Wednesday, 02 November 2022 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storms from 03 November. Likelihood of Active electron fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours. The largest regions on the disc, AR3131 and AR3135, have both been stable with only minor changes. AR3136 has evolved relatively rapidly with developing complexity. The remaining regions are simple and weak, presenting very little risk of significant flares at present. A filament eruption and subsequent CME from the northwest quadrant late on 01 November has been analysed and assessed to not have any Earth directed component. Another CME leaving the northeast of the solar disc early on 02 November will be analysed once further imagery becomes available.

Solar Wind / Geomagnetic Activity: The solar wind, observed by DSCOVR at L1, has been steady for much of the period, averaging between 400-500km/s until 02/0400UTC, after which the speed increased slightly to around 475km/s until 02/0600UTC. There has been a more marked and sustained increase to 480km/s since 02/1145km/s. Density was mainly below average, but with a steep rise to average values from 02/1000UTC. Total magnetic field strength was weak, but increased steadily towards moderate values from 02/0600UTC, reaching 8nT by the end of the period. The north-south component, Bz, has varied weakly, with a negative bias through much of the period, then a sharp negative peak of -7nT at 02/1227UTC. All these observations indicate a modest transition into the high speed stream of coronal hole 38. Phi angle was mainly positive (towards the Sun) with very brief transitions into the negative sector. Geomagnetic activity was Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2MeV) at GOES-16 has been at moderate or high levels on a diurnal cycle, with a peak of 1.78e3 at 01/1655UTC. Electron fluence levels were below the Active threshold with a peak value of 6.45e7 integrated pfu observed at 02/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low, with an increasing chance of isolated Moderate activity as further active regions are due to rotate onto the visible disc.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast. The Earth is under the influence of a weak high speed stream from coronal hole 38. This is due to subside early on 03 November, followed by an anticipated connection to the high speed stream from coronal hole 39, either late on 03 or early on 04 November. This feature is forecast to produce speeds in the region of 500-600km/s. Geomagnetic activity will be mainly Quiet to Unsettled through much of the period, but with a risk of Active on 02 November and Active or G1/Minor Storms from late on 03 November.

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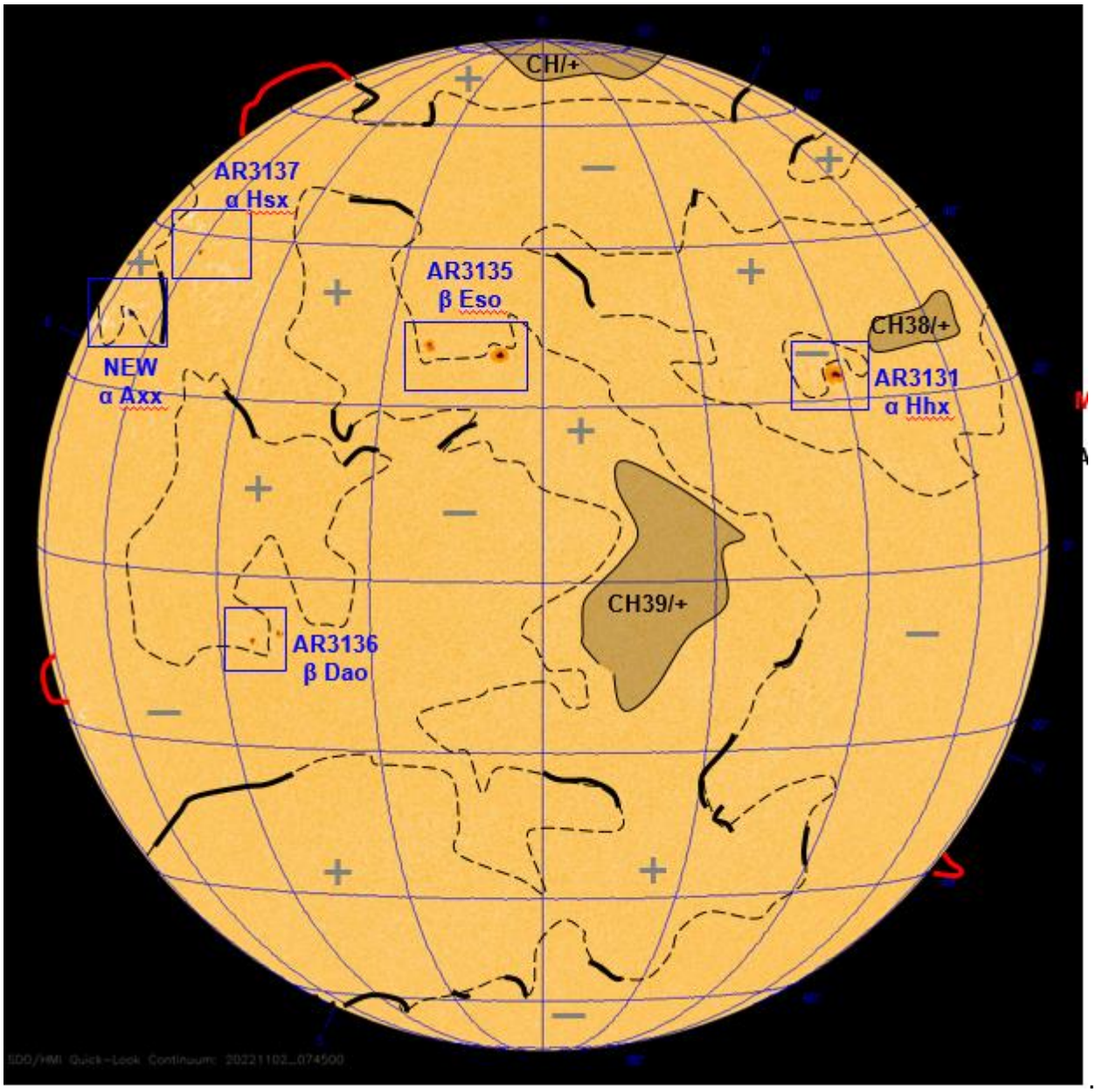
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) observed by GOES-16 is forecast to be at moderate to high levels through the period. The associated 24 hour electron fluence is expected to continue close to or just above the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 02/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
No Earth-directed CMEs are forecast, although a recent eruption from the northeast quadrant is awaiting analysis.

Earth appears to be slowly connecting to the high speed stream from coronal hole 38 with speeds likely to peak at 500km/s. This appears to be a delayed onset based on estimates of the solar wind speed for the previous rotation. Based on observations from STEREO A, this feature is likely to stay connected with Earth for around 24 hours, with winds expected to ease during the first half of 03 November. The high speed stream from coronal hole 39 is then due to connect with Earth either late on 03 November, or during 04 November. Speeds from this feature are expected to be in the range 500-600km/s. On the last rotation speeds from this coronal hole reached close to 500km/s, but this is a much stronger coronal hole on this occasion.

Geomagnetic activity is forecast to be mainly Quiet to Unsettled during 02 November, with a slight chance of Active intervals, this risk continuing into early on 03 November. The onset of the next high speed stream is expected to lead to a chance of Active or G1/Minor Storm intervals, with this risk slowly decreasing through the following two days. Based on the strength of the hole, there is a risk of further G1/Minor Storm intervals in any sustained periods of negative Bz.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	40	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Recent solar wind parameters observed at L1. The move into the HSS from coronal hole 38 is clearly discernible towards the end of the period.

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Radio Blackouts - X-Ray Flares:

There are five sunspot regions on the visible disc. The two largest of these, AR3131 and AR3135 appear mature and stable. AR3136 appears to be developing and could present a significant flare risk later in the period, with the remaining regions appearing small and weak. Farside data suggests that a number of significant active regions could rotate into the visible disc over the next four days, including ex-AR3122 which was a large, active sunspot on the previous rotation.

Solar activity is expected to be mainly Low or Very Low, but with an increasing risk of Moderate activity from 03 November onwards.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background and is forecast to remain at this level through the guidance period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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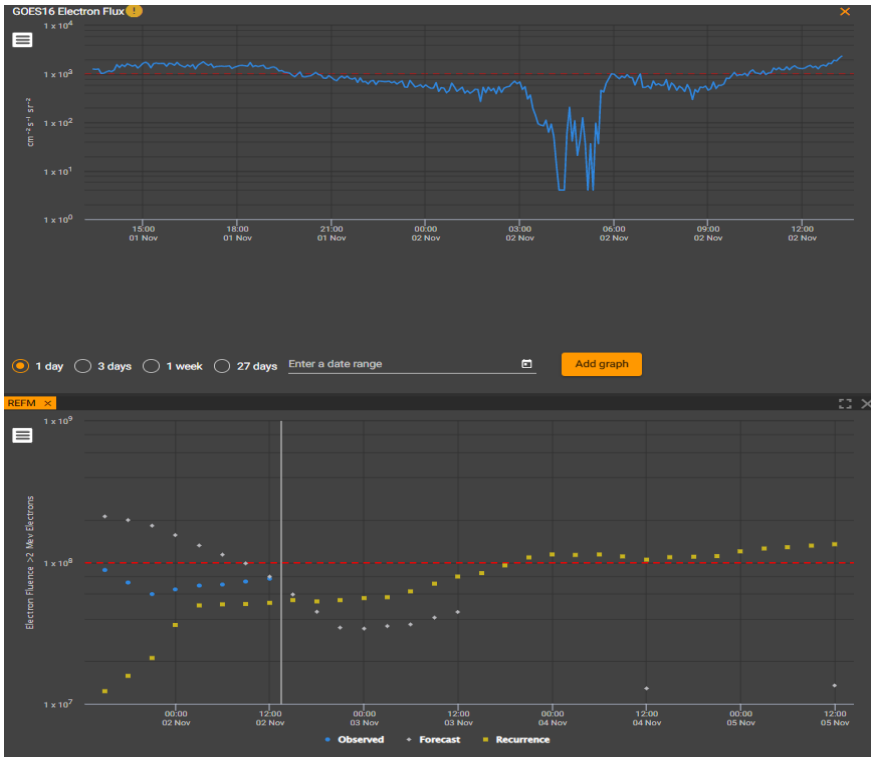
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) is currently oscillating through moderate to high levels on a diurnal cycle. This pattern is expected to continue through the period, based on electron belt models with the radiation belts receiving a feed of electrons from recent high speed streams. There is a likelihood that the onset of a high speed stream either late on 03 November or early on 04 November could be strong enough to distort the belts out of their natural orbits and lead to a dip in the flux, with a sharp recovery as the belts relax later in the period as the potential strong solar wind eases.

Electron fluence has followed an upward trend after falling just below the Active threshold in the last 24 hours. The longevity of this trend is uncertain, but there remains a continued risk of the fluence exceeding the Active threshold over the next four days in the high electron flux environment.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	70	50	50	70
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: GOES 16 electron flux and MOSWOC REFM fluence observations and model.



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